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Claims

1. Method for synchronizing, between the cylinders of an
internal combustion engine, the differences in the quantity of
fuel injected, in which the differences in the quantity of
fuel injected which exist at an operating point in the lower
engine-speed range with the injection parameter values valid
at that point under normal operating conditions are determined
by means of a method of measuring individual cylinders to
record irregularities in the running of the internal
combustion engine and are assigned to the low operating point
and in which, for operating ranges with higher loads and
engine speeds, an adaptation of the differences in the
quantity of fuel injected is carried out for a chosen
injection parameter,
characterized in that
at the low operating point the chosen injection parameter is
set for adaptation (4, 5, 6, 7) to a value which deviates from
the value applicable at that point under normal operating
conditions, and in that for the set value the differences in
the quantity of fuel injected are determined by means of
measurement of the irregularities in the running of the engine
and are learned as adaptation values which are assigned to the
respective injection parameter value, wherein during the
adaptation (4, 5, 6, 7) the movement of the operating point,
which changes with the injection parameter value set in each
case, is limited.

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2. Method according to Claim 1,
characterized in that, in order to limit the movement of the
low operating point during adaptation (4, 5, 6, 7), at least
one second injection parameter is set such that the operating
point remains at least approximately stationary.

3. Method according to Claim 2,
characterized in that, in the process of adaptation (4, 5, 6,
7) to successively higher values of the injection pressure
chosen as an injection parameter, a correspondingly shorter
injection period is set in order to limit the movement of the
low operating point.

4. Method according to Claim 2,
characterized in that, in the process of adaptation (4, 5, 6,
7) to successively lower values of the injection pressure
chosen as an injection parameter, a correspondingly longer
injection period is set in order to limit the movement of the
low operating point.

5. Method according to any one of Claims 2 or 3, characterized
in that the injection pressure is changed gradually by a
defined amount.

6. Method according to any one of the preceding claims,
characterized in that for the adaptation (4, 5, 6, 7) a low
operating point is selected at which the maximum sensitivity
and/or reliability of measurement of the irregularity in the
running of the engine is achieved.

7. Method according to any one of the preceding claims, characterized in that the low operating point is chosen in the idling range.

8. Method according to any one of the preceding claims, characterized in that the learned adaptation values serve to calculate cylinder-specific correction factors, which are applied to an activation parameter of an injection device of the internal combustion engine such that a synchronization of the quantities of fuel injected occurs.

9. Method according to Claim 8, characterized in that the injection device for each cylinder is formed by an injector with a piezoelectric actuator, wherein the activation energy of the actuators is used as an activation parameter.

10. Method according to Claim 9, characterized in that, for a defined loading/unloading time of the injector, the actuator energy is adapted correspondingly.

11. Method according to Claim 10, characterized in that the loading/unloading time of the main injection is set to an initial value (τ_0) and is gradually changed to an extreme value, wherein with each step the actuator energy is adapted correspondingly.

12. Method according to any one of the preceding claims, characterized in that, in order to record the irregularity in the running of the internal combustion engine, the angular

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acceleration of the crankshaft of the internal combustion
engine caused by the differing quantities of fuel injected in
individual cylinders is analyzed.

13. Method according to Claim 12,
characterized in that, at the stationary operating point set
for adaptation (4, 5, 6, 7) with synchronized quantities of
fuel injected, the absolute value of the associated quantity
of fuel injected is determined from a stored model of the
torque of the internal combustion engine.